



HB Calibration from TB 2002 data

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Data Flow

>>> front end <<<

Scint. Lights

->Tile->Fiber1&2->OptCable
->HPD->Amp->ADC(7bits)->

Charge (for 5-10xings)

->(L1Path)
->(DAQPath)

>>> L1Path <<<

->**HTR** (ch)

$E_T(\text{L1Primitive: 8bits:non-linear})$

->**L1 LUT** (ch)

$E_T(4 \times 4 \text{ HcTower: 8bits:linear})$

->L1Calo

$E_T(\text{L1jets}), E_T(\text{L1tau}), E_T(\text{L1MET})$

->L1CaloGlobal(**Threshold** (obj))

->L1Global

L1Trigger

>>> after DAQPath <<<

->**ReadoutAnalyzer** (ch)

$E_T(\text{channel})$

->TowerCreator

$E_T(\text{Ec+Hc Tower})$

->Jet/MET/tauReco

$E_T(\text{jetR}), E_T(\text{tauR}), E_T(\text{METR})$

->**EtCaloCorrection** (obj)

(corr. for linearity)

$E_T(\text{JetC}), E_T(\text{tauC}), E_T(\text{METC})$

->**EtPhysCorrection** (obj)

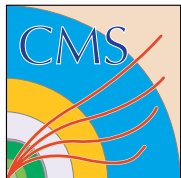
(corr. for out-of-cone)

$E_T(\text{Parton})$

Calibration/correction

(ch) - channel by channel

(obj) - phys. Obj, (jet, tau, MET)



Tools

A) Megatile scanner:

- Collimated Co^{60} gamma source
 - each tile: light yield
 - during construction
- all tiles

B) Moving radio active source:

- Co^{60} gamma source
 - full chain: gain
 - during CMS-open (manual)
- all tiles
- during off beam time (remote)
- tiles in layer 0 & 9

C) UV Laser:

- full chain: timing, gain-change
 - during off beam time
- tiles in layer 0 & 9
- all RBX

D) Blue LED:

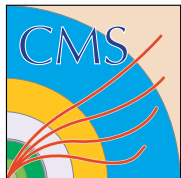
- timing, gain change
 - during the off beam time
- all RBX

E) Test beam

- normalization between
GeV vs. ADC vs. A,B,C,D
 - ratios: elec/pion, muon/pion
 - before assembly
- a few wedges

F) Physics events

- mip signal, link to HO
muon
 - calo energy scale (e/pi)
charged hadron
 - physics energy scale
photon+jet balancing
Z+jet balancing
di-jets balancing
di-jet mass
W->jj in top decay
- >> non-linear response
- >> pile-up effect



Scenario (HB/HE)

(same to HF)

1) Before megatile insertion

- megatile scanner: **all tiles**
- moving wire source: **all tiles**

2.1) After megatile insertion

- moving wire source: **all tiles / 2 layer**
- UV laser: **2 layers/wedge**

2.2) After megatile insertion

- test beam: **a few wedges.**

Absolute calib.
Accuracy of 2%
for single particle

3) Before closing the CMS

- moving wire source: **all tiles**
 - UV laser & blue LED: **all RBX**
- (do 3, about once/year)

4) Beam off times

- moving wire source: **2layer/wedge**
- UV laser: **2 laer/wedge**
- UV laser & blue LED: **all RBX**

Monitor for change
with time
Accuracy < 1%

5) Beam on (in situ)

- jets / tau / MET **ECAL+HCAL**

once/month

a few times/day (?)



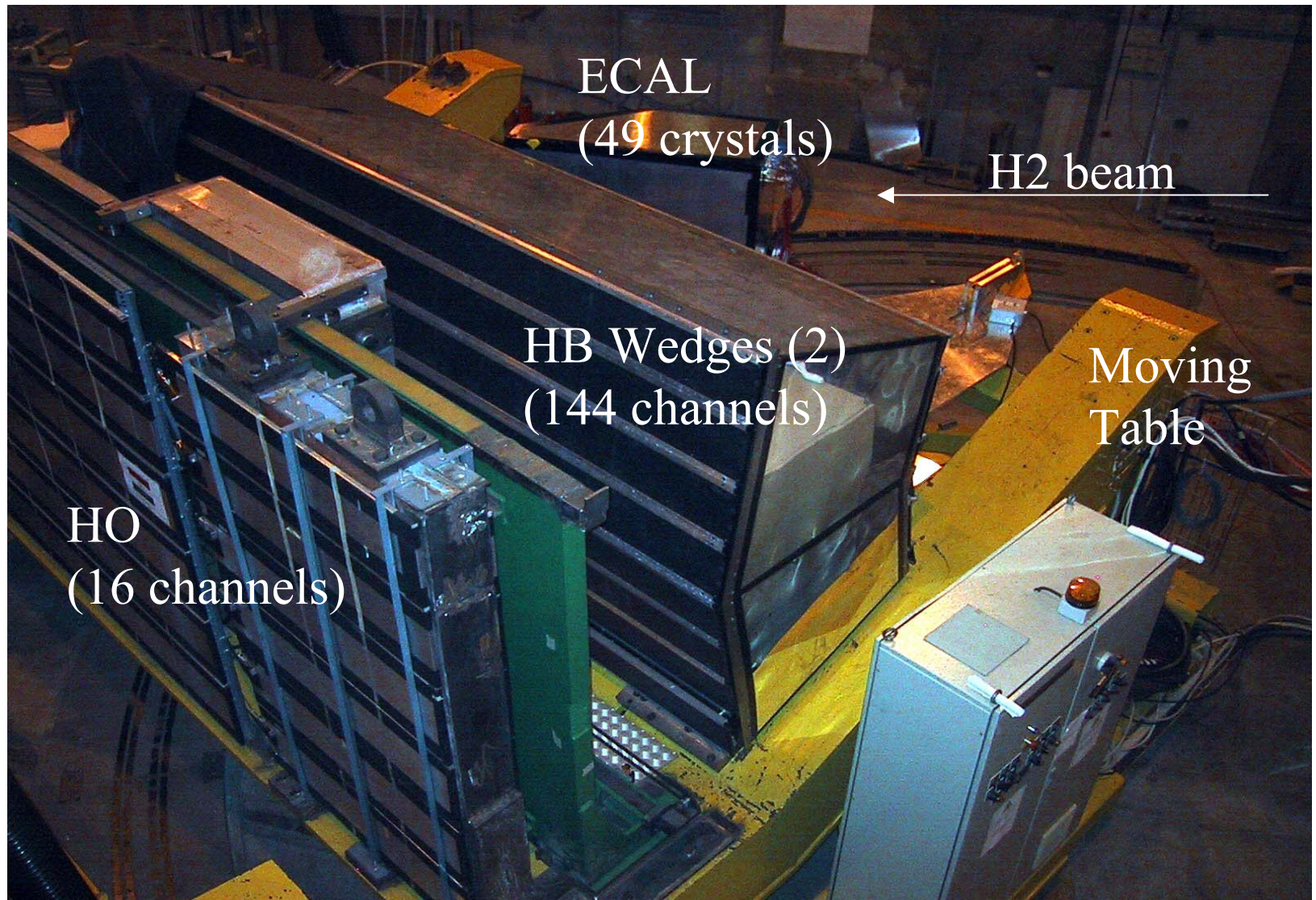
HCAL+"ECAL" Layout

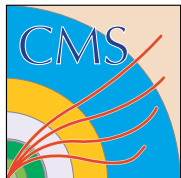


**Calibrate 4
wedges '02.
Check HO
response as
tail catcher
and as
muon
trigger
element. In
'03 use PPP
to study 40
MHz beam
and HE/HB
transition
region.**



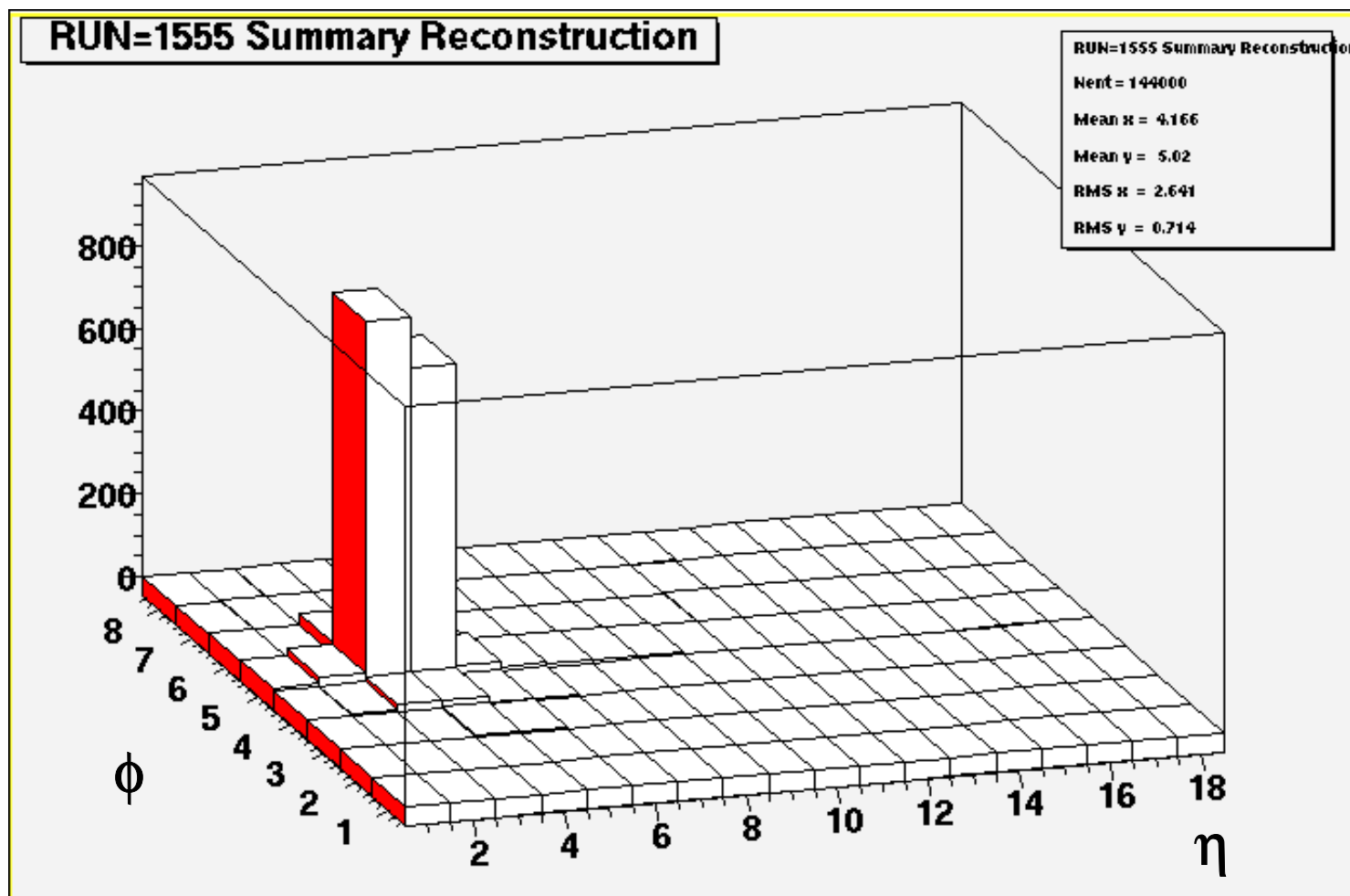
Testbeam Layout





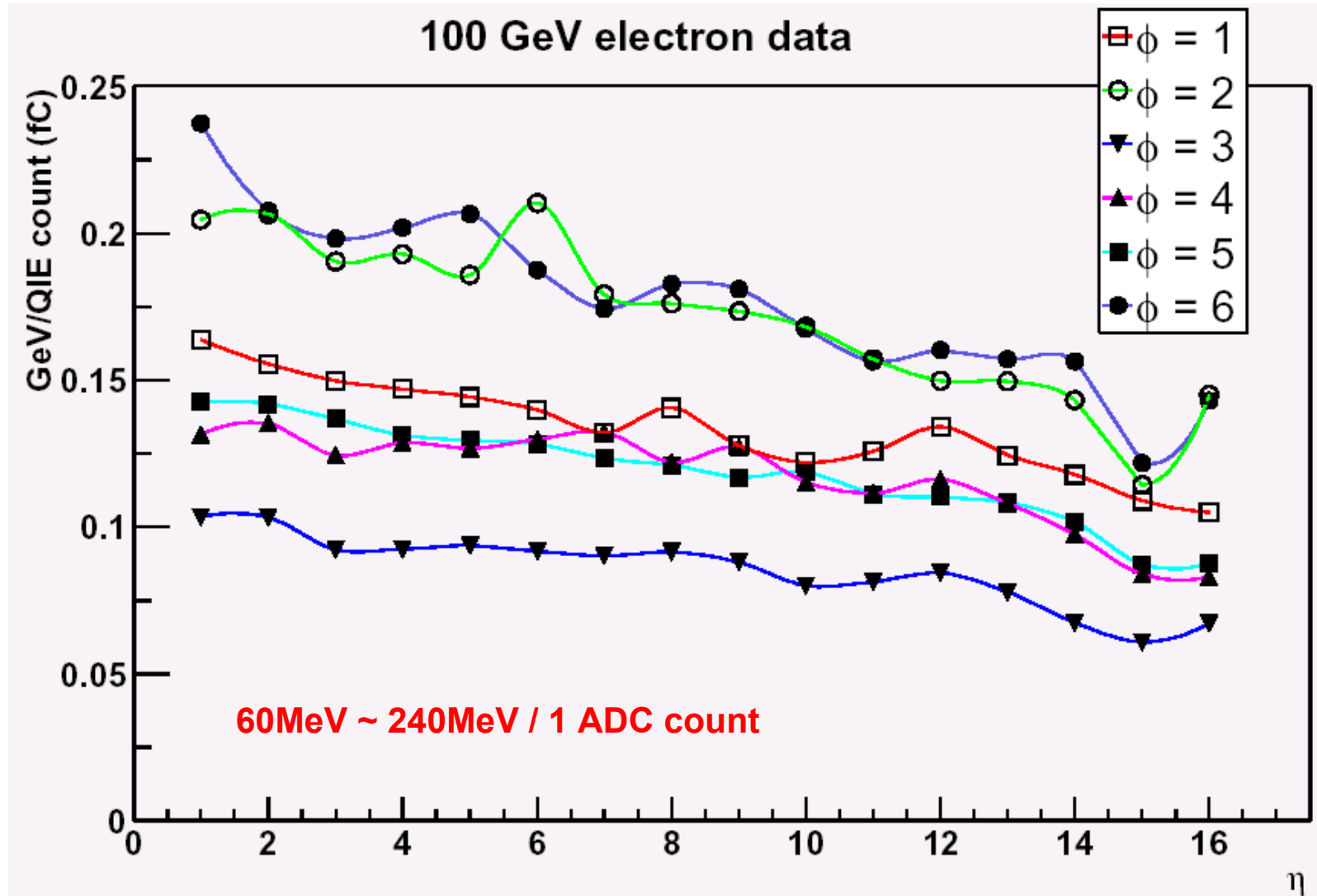
HB 2 Wedges - $16\eta \times 8\phi$

300GeV π^-





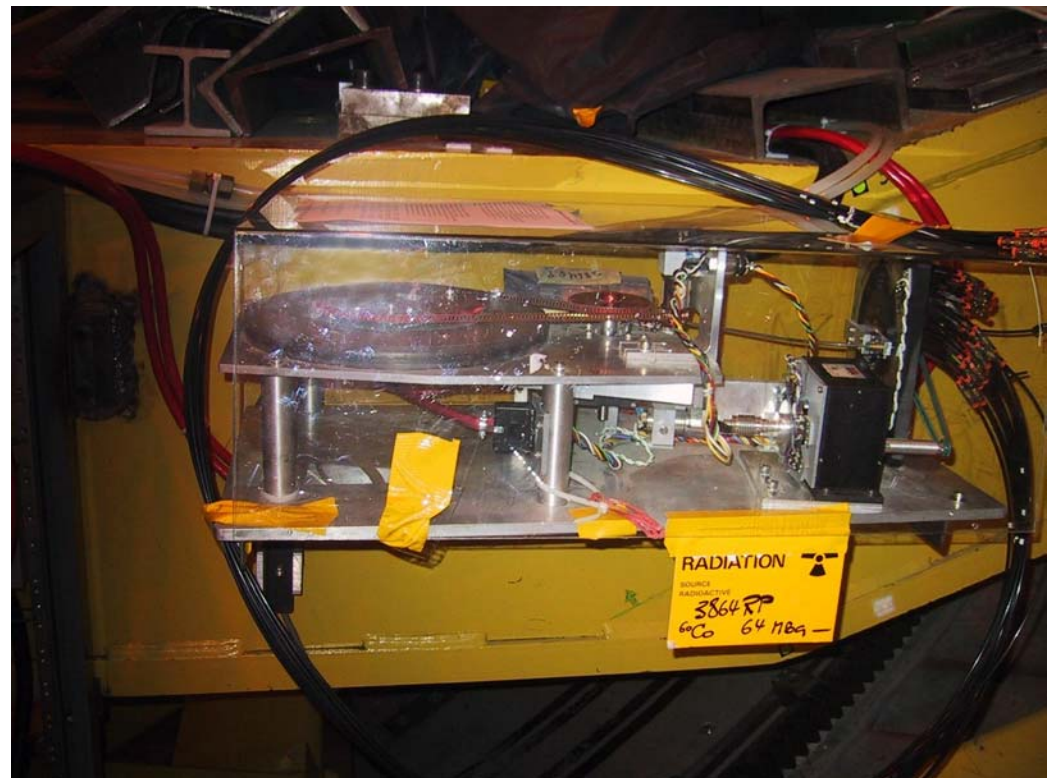
GeV/ADC

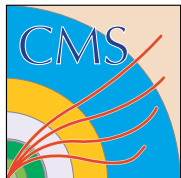




Source scan uses QIE at 25 nsec to sum up to a D.C. current. Signal to noise is good (3 mCu). Assignment of calibration constant to tile is simple.

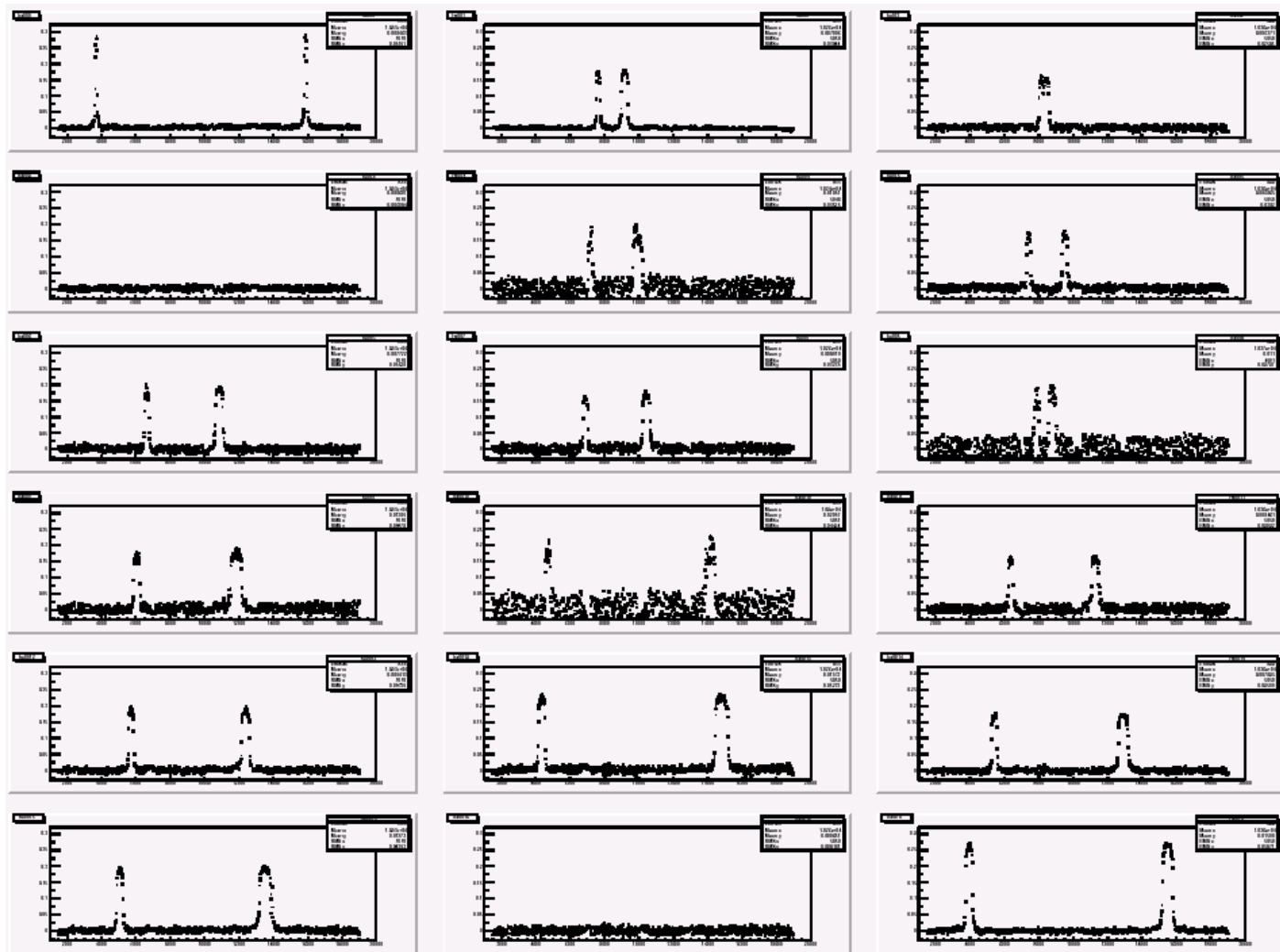
Wire Source Scan





Wire Source

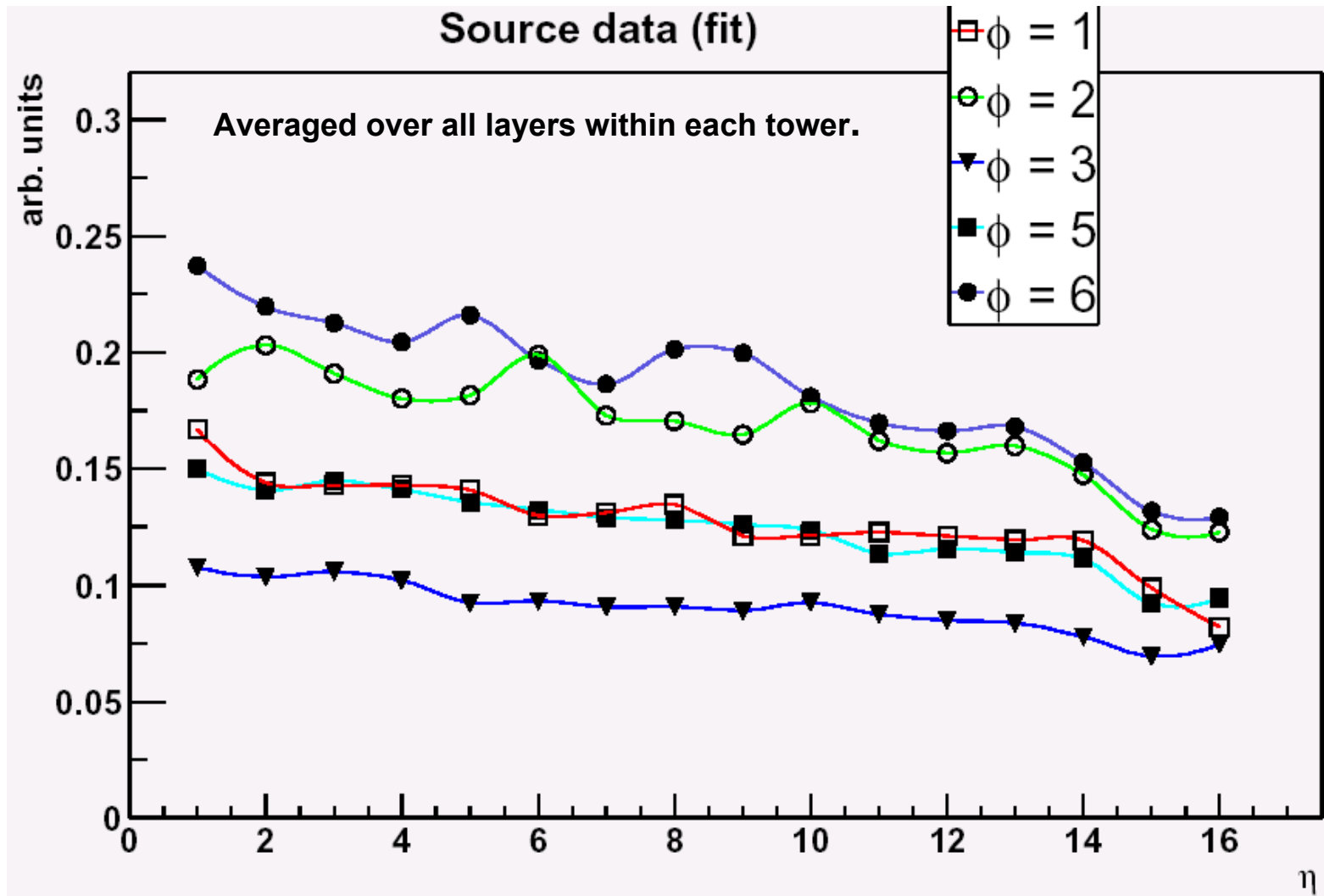
each point – gaussian fit to histograms



Some channels are noisier than others.

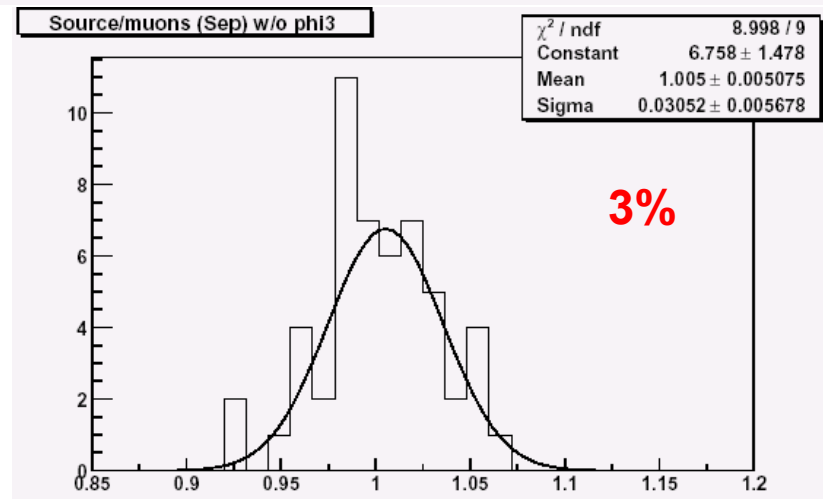
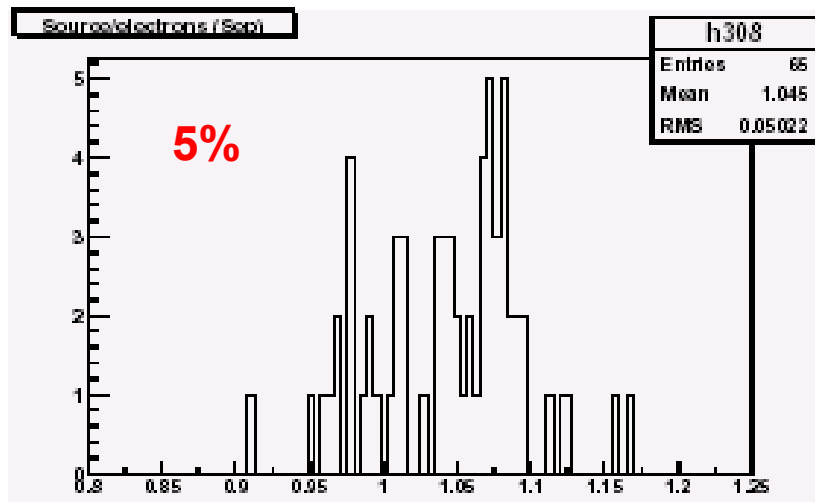
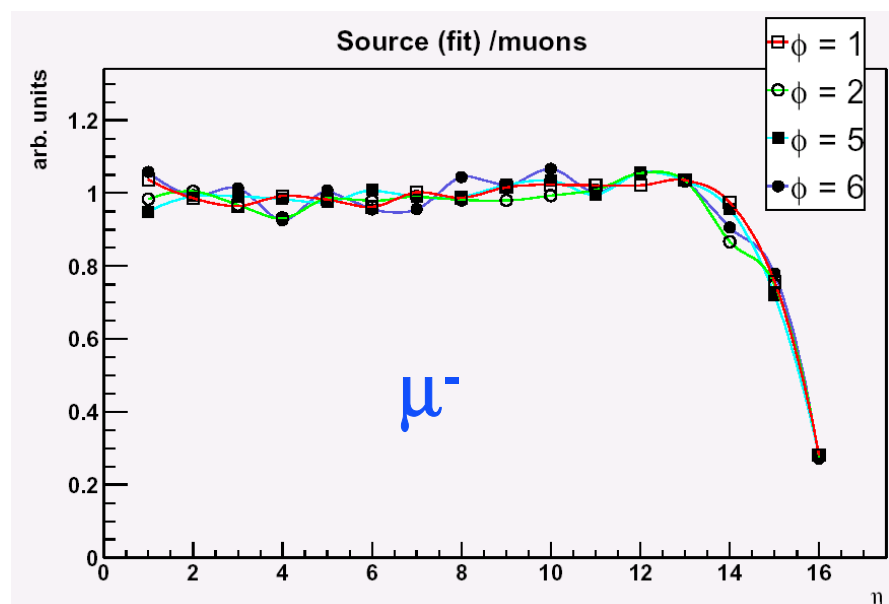
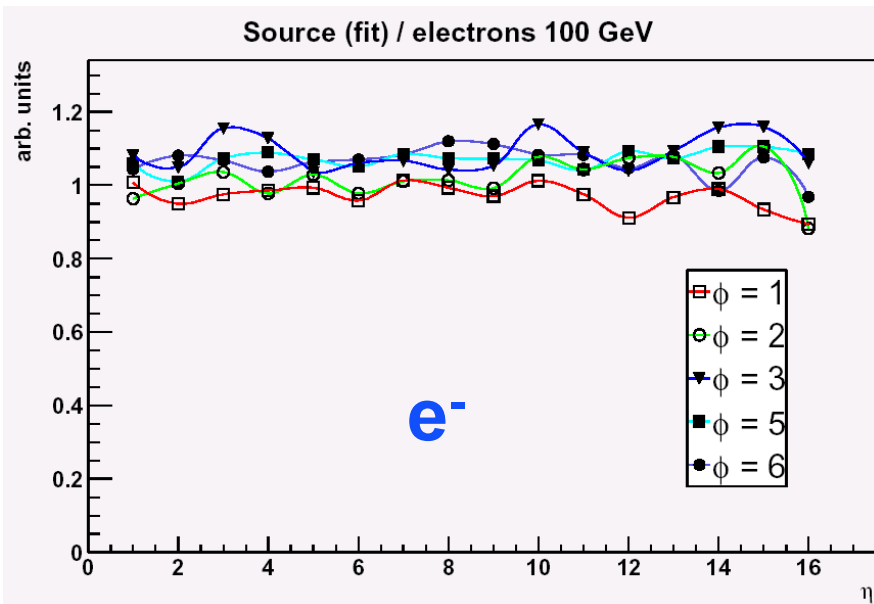


Wire Source Data





Source vs Beam Data





Calibration Constants from Wire Source Data

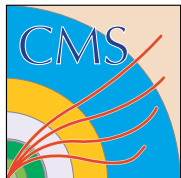
Format (original)

Wedge (1-2)
Phi (1-4)
Layer (0-16)
Tower (1-18)
Peak (extend+retract)/2.0
Dpeak (extend-retract)/2.0
Event number (extend peak)
Days since 01-March-1999
Pedestal
Pedestal RMS

New

Phi(1-8)
Tower (1-18)
Layer (0-16)
Amplitude(fit)
Amplitude(max)
Amplitude RMS (fit)
Pedestal rms
Pedestal deviation
Amplitude (cap1)
Amplitude (cap2)
Amplitude (cap3)
Amplitude (cap4)
HTR #
Channel #
Run #

Need to finalize the format.



Calibration Data Sets (HB)

Lab5

- Collimated source
- Moving wire source

Bld186

- Moving wire source

TB2002

- Moving wire source
 - Root file/root script/Fermilab&CERN → simple ASCII file
- Beam data
 - Root file/reco+scripts/Fermilab&CERN → simple ASCII file

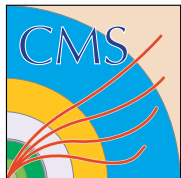
Detector components

- Geometry – absorbers, scintillator tiles, fibers
 - HPD – QE & gain
 - QIE/card – linearity (each cap ID)
- Need naming and labeling scheme

Plan: initial version in “database” by March 2003.



Some other results



HB Testbeam 2002

Dates:

- June 26-July 1 “ECAL” // July 24-July 31 HF // Aug. 01- Sep. 18 HB

Goals (HB):

- Demonstrate 144ch working
- Demonstrate DCS going
- Source data vs GeV/ADC
- Muon signal in HO for muon trigger
- Eta dependence (attenuation)
- Eta dependence (timing)
- Pulse shape (needs TDC)
- Weight in Layer 0

(beam: $e / \mu / \pi$)

→ start construction of Calibration Database

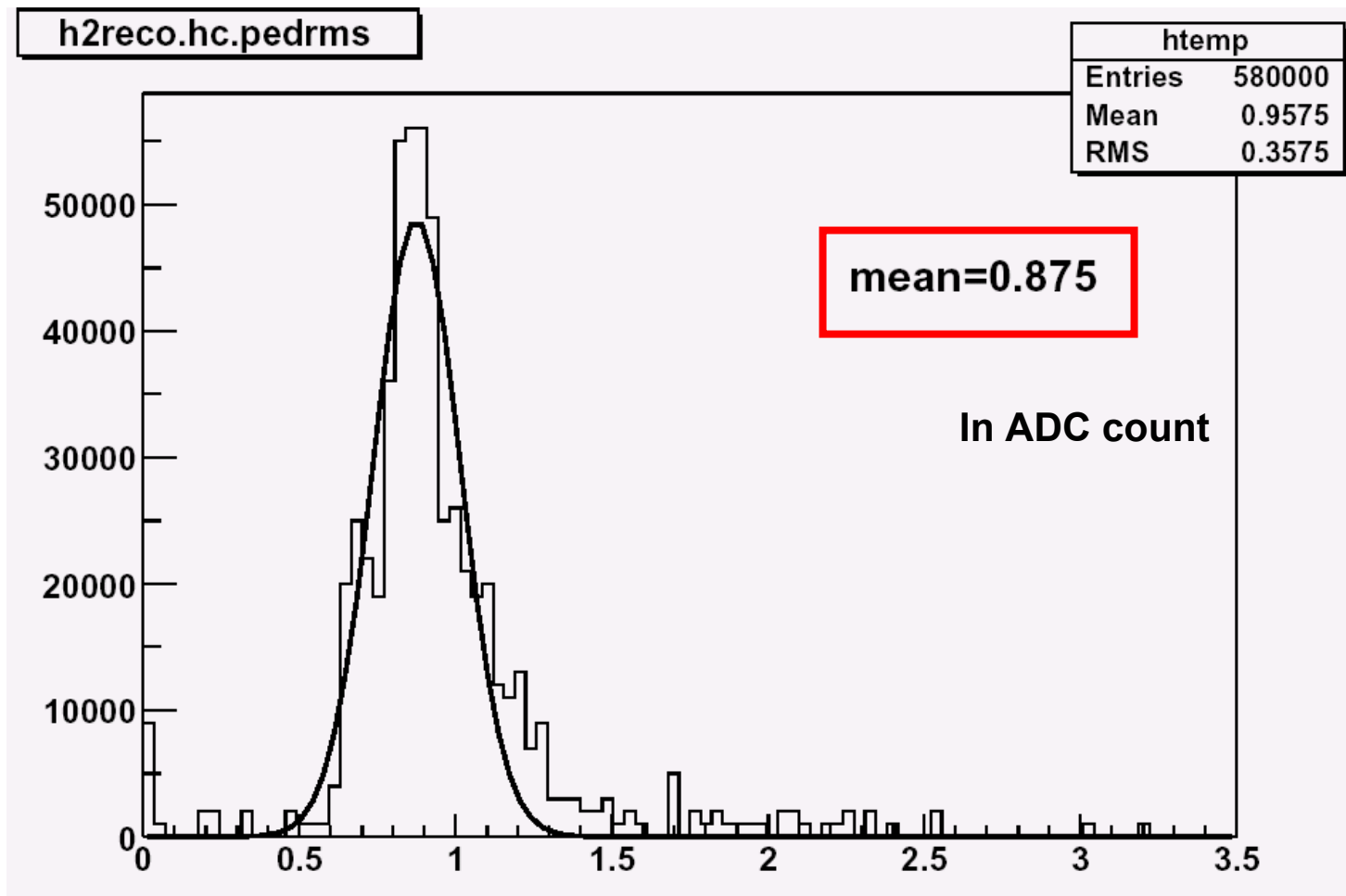
Additional Goals (left over from 1999TB)

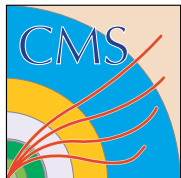
- Crack between wedges
- e/π (resolution and linearity)
- Cerenkov light in clear fibers



Noise Level

Pedestal RMS distribution

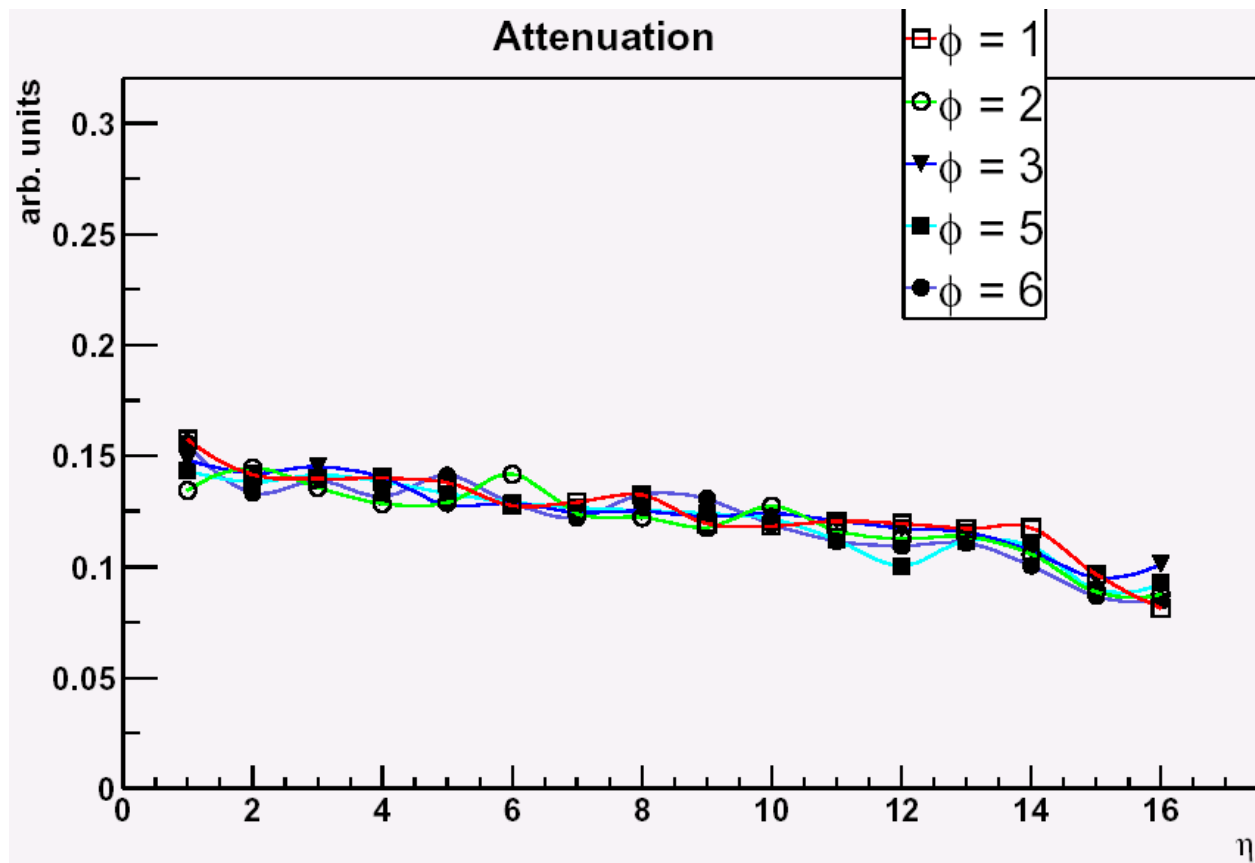




Variation in eta

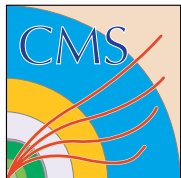
Eta 1/attenuation

1	1
2	0.947
3	0.947
4	0.918
5	0.904
6	0.887
7	0.847
8	0.862
9	0.831
10	0.825
11	0.786
12	0.756
13	0.769
14	0.730
15	0.618
16	0.605



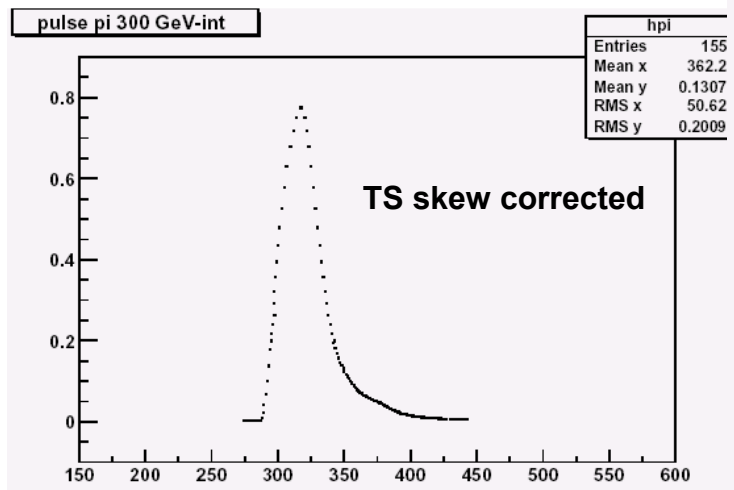
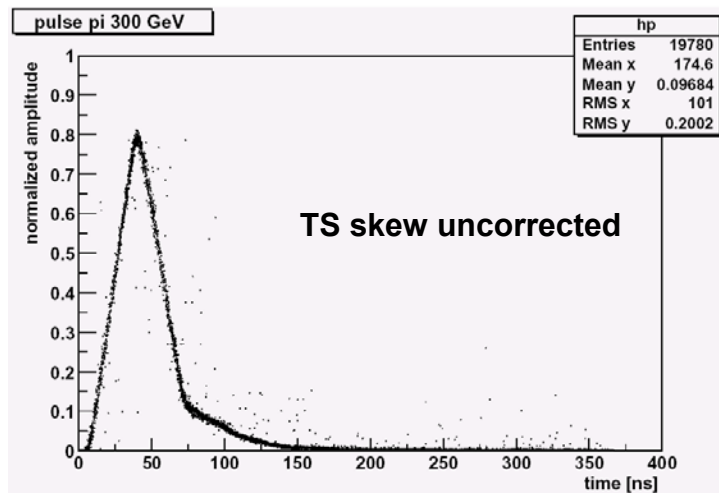
2.5TeV
 3.0TeV
 4.1TeV

1.8TeV
 2.2TeV
 3.0TeV

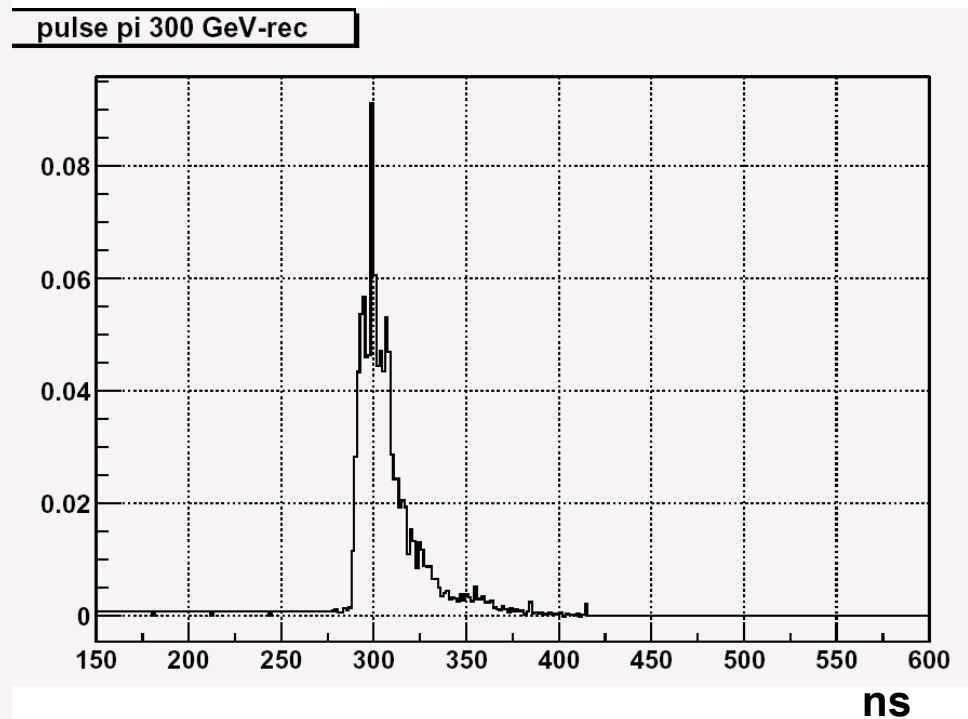


Pulse Shape

E in 30ns time slices

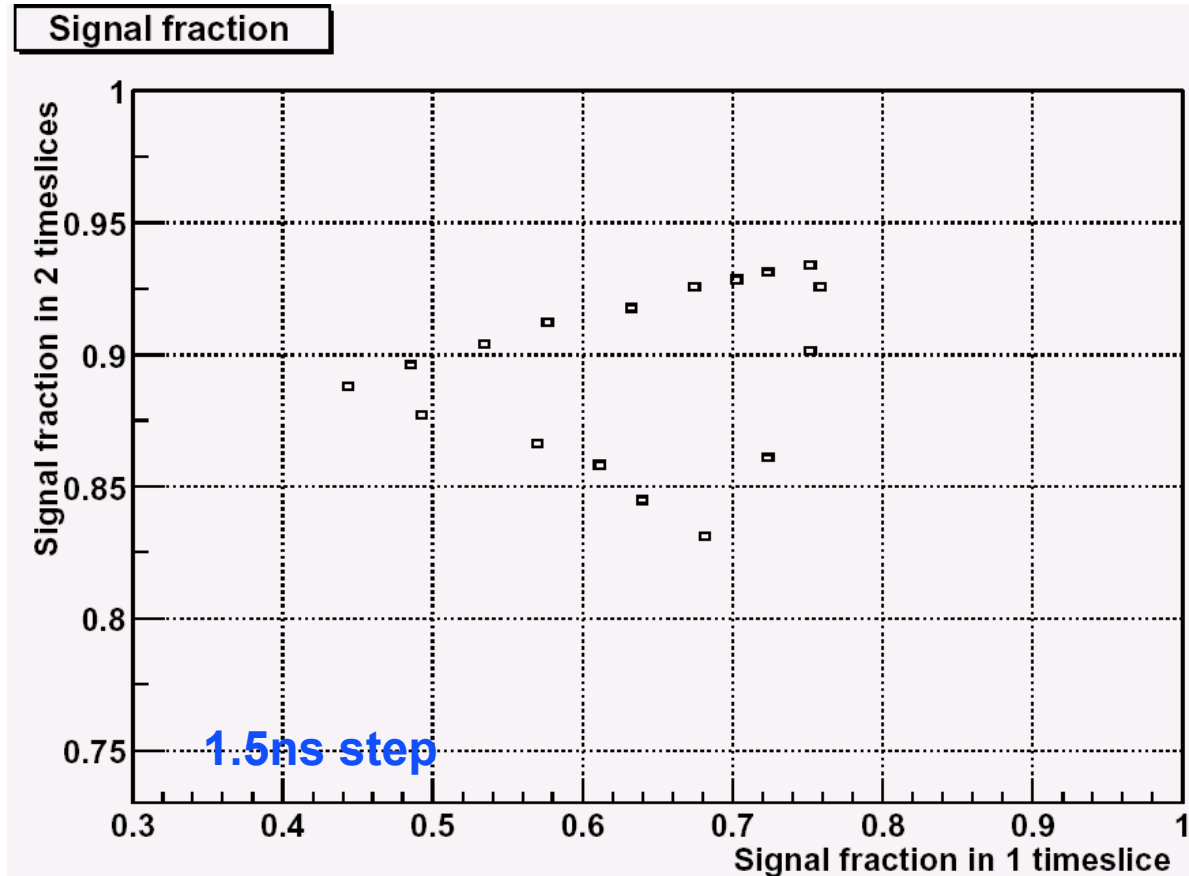


Reconstructed pulse shape

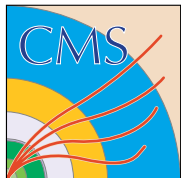




Energy Collection

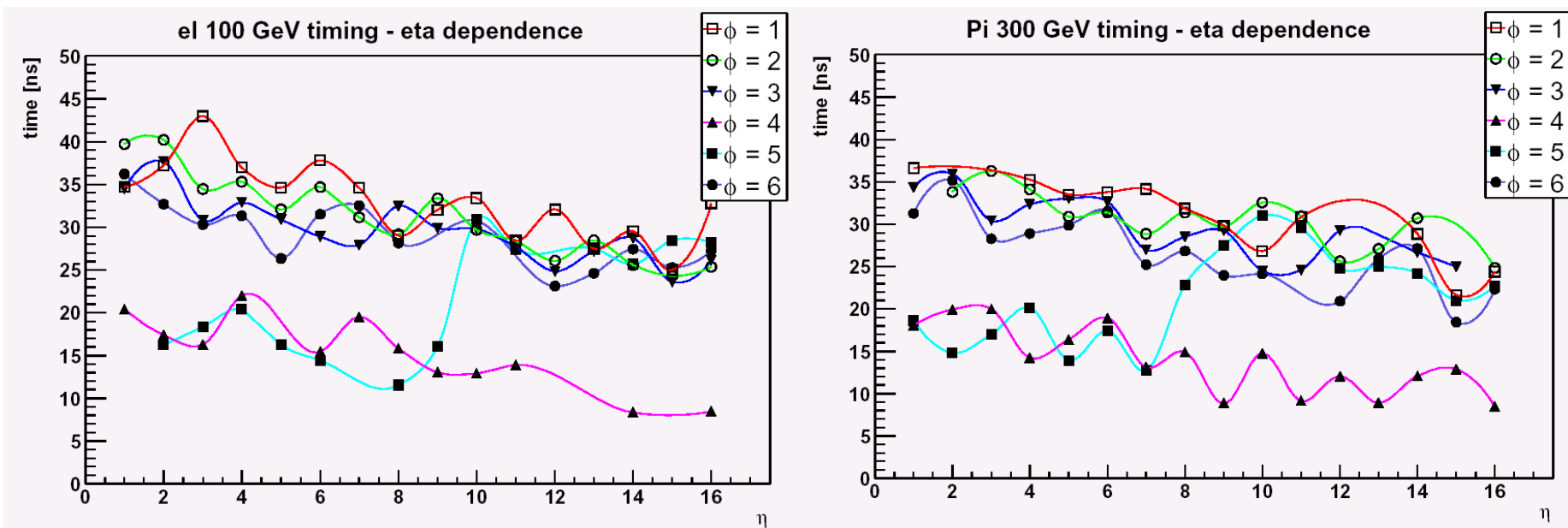


Variation 2% (5%)
1 TS- 3ns (6ns)
2 TS- 6ns (12ns)

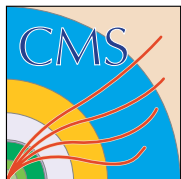


eta dependence timing

Calculated using corrected TS mean.

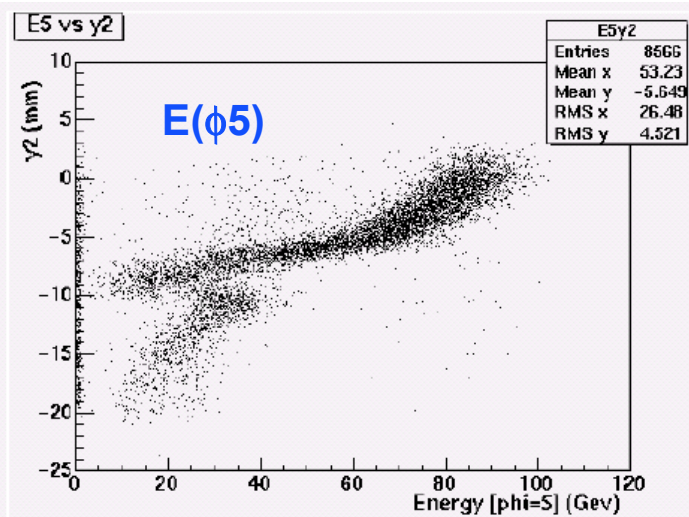
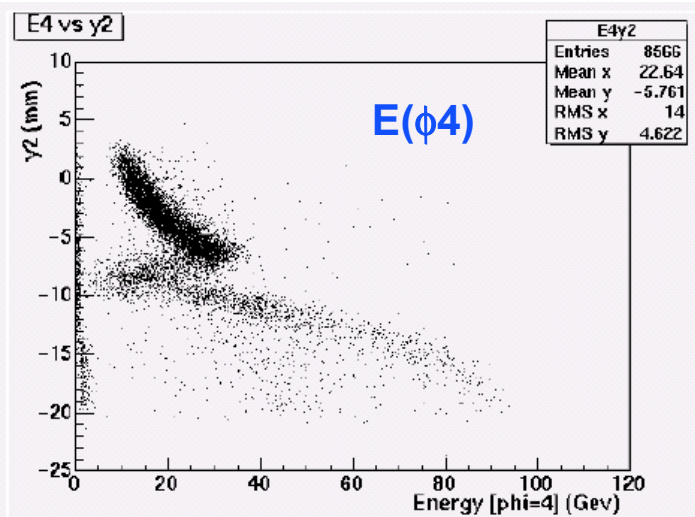


~10ns spread in eta 0 – 16

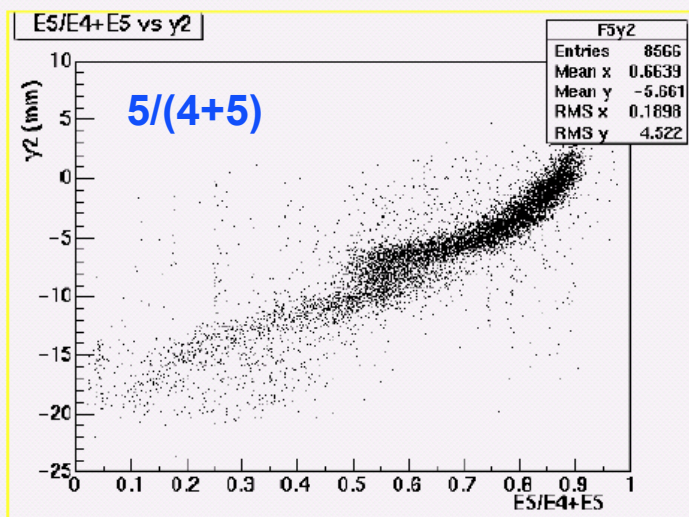
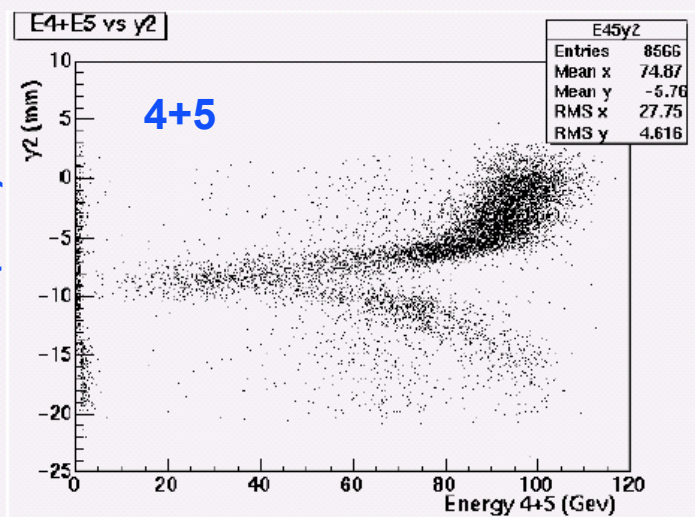


Crack between Wedges 100GeV electron

Y2 (mm)



Y2(mm)



air gap:
a few mm

put in MC

(Rick Vidal)